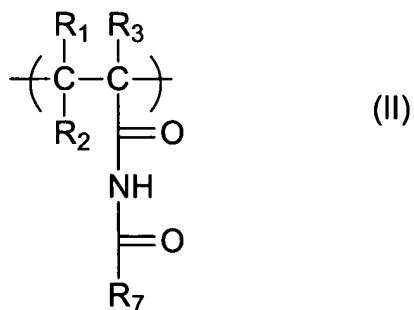


5

- $$\begin{array}{c}
 \begin{array}{c}
 R_1 \quad R_3 \\
 | \quad | \\
 \text{---} (C - C) \text{---} \\
 | \quad || \\
 R_2 \quad O \\
 | \\
 O \\
 | \\
 Y
 \end{array} \\
 \begin{array}{c}
 \begin{array}{c}
 R_{20} \\
 | \\
 R_{22} - C - \text{---} \\
 | \quad \diagup \\
 R_{24} \quad \text{C=O} \\
 \quad \quad \diagdown \\
 \quad \quad N
 \end{array}
 \begin{array}{c}
 \begin{array}{c}
 R_{36} \quad OH \\
 | \quad / \\
 R_{32} \quad C - \text{---} \\
 | \quad \diagdown \\
 R_{34} \quad \text{C=O} \\
 \quad \quad \diagup \\
 \quad \quad R_{32}
 \end{array}
 \end{array}
 \end{array}
 \end{array}
 \quad (I)$$



10

defined above; R<sub>32</sub>, R<sub>34</sub>, and R<sub>36</sub> are independently selected from hydrogen, alkyl, aryl, aralkyl, or 5-, 6-, or 7-membered heterocyclic ring containing at least one heteroatom selected from nitrogen, oxygen or sulfur; and Y is selected from linear or branched alkylene, monocyclic or polycyclic alkylene, arylene,

5 aralkylene, polyoxyalkylene, linear or branched alkenylene, monocyclic or polycyclic alkenylene, aromatic or non-aromatic heterocyclic diradical and alicyclic diradical groups, the alkyl, aryl, aralkyl, heterocyclic ring, carbocyclic ring, linear or branched alkylene, monocyclic or polycyclic alkylene, arylene, aralkylene, polyoxyalkylene, linear or branched alkenylene, monocyclic or  
10 polycyclic alkenylene, aromatic or non-aromatic heterocyclic diradical and alicyclic diradical being unsubstituted or substituted.

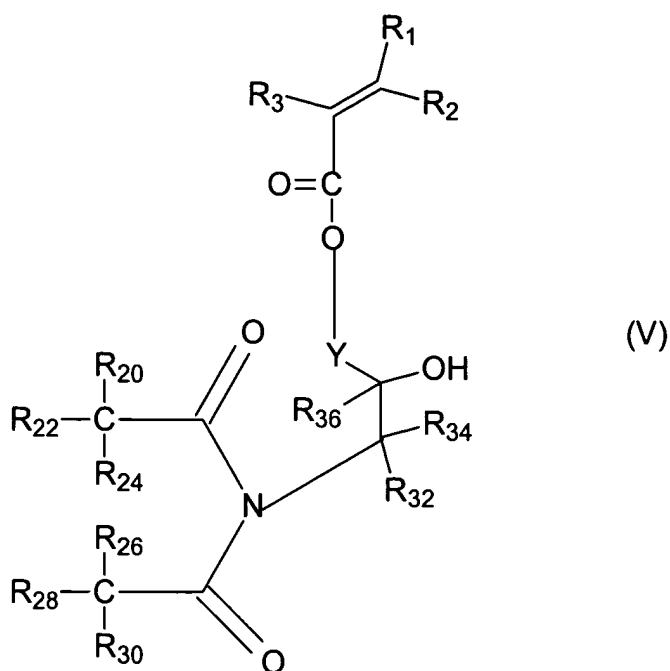
2. The polymer of claim 1 which further comprises an additional monomer.

15 3. The polymer of claim 2 wherein the additional monomer is selected from optionally substituted acrylic esters, optionally substituted acrylic acids, optionally substituted methacrylic esters, optionally substituted methacrylic acids, optionally substituted acrylamides, optionally substituted methacrylamides, optionally substituted allyl compounds, optionally substituted styrenes, optionally  
20 substituted hydroxystyrene, optionally substituted hydroxyisopropylstyrene, optionally substituted methylstyrene, optionally substituted hydroxymethylstyrene, optionally substituted hydroxyl- $\alpha$ -methylstyrene, optionally substituted vinyl ethers, optionally substituted vinyl esters, optionally substituted crotonic acids, optionally substituted crotonic acid esters, optionally substituted  
25 maleic anhydride, optionally substituted dialkyl itaconates, optionally substituted monoalkyl or dialkyl esters of maleic acid or fumaric acid, and mixtures thereof.

4. The polymer of claim 3 wherein the additional monomer is selected from optionally substituted methacrylic esters and optionally substituted styrenes.

30

5. The polymer of claim 4 wherein the methacrylic esters contains a pendent hydroxyl group.
6. The polymer of claim 1 wherein the repeating unit is represented by  
5 formula (I).
7. The polymer of claim 6 wherein Y is linear or branched alkylene.
8. The polymer of claim 6 wherein each of  $R_{32}$ ,  $R_{34}$ , and  $R_{36}$  are  
10 independently hydrogen.
9. The polymer of claim 6 wherein  $R_{24}$  and  $R_{26}$  taken together form a direct bond.
10. The polymer of claim 6 wherein  $R_{24}$  and  $R_{26}$  taken together form  
15  $-(CH_2)_{n1}(O)_{n2}(CH_2)_{n3}-$ .
11. The polymer of claim 6 wherein  $R_{24}$  and  $R_{26}$  taken together with the  
carbon atoms to which they are attached form a carbocyclic ring.  
20
12. The polymer of claim 1 wherein the repeating unit is represented by  
formula (II).
13. A compound having the formula  
25



where  $R_1$ ,  $R_2$ , and  $R_3$  are each independently selected from hydrogen or alkyl;  
 $R_{20}$ ,  $R_{22}$ ,  $R_{24}$ ,  $R_{26}$ ,  $R_{28}$ , and  $R_{30}$  are independently selected from hydrogen, alkyl,  
 5 aryl, aralkyl, or 5-, 6-, or 7-membered heterocyclic ring containing at least one  
 heteroatom selected from nitrogen, oxygen or sulfur, or  $R_{24}$  and  $R_{26}$  taken  
 together (i) form a direct bond, (ii) form  $-(CH_2)_{n1}(O)_{n2}(CH_2)_{n3}-$  where  $n_2$  is 0 or 1  
 and  $n_1+n_2+n_3 = 1$  to 5, or (iii) with the carbon atoms to which they are attached  
 form a carbocyclic ring and  $R_{20}$ ,  $R_{22}$ ,  $R_{28}$  and  $R_{30}$  are as defined above;  $R_{32}$ ,  $R_{34}$ ,  
 10 and  $R_{36}$  are independently selected from hydrogen, alkyl, aryl, aralkyl, or 5-, 6-,  
 or 7-membered heterocyclic ring containing at least one heteroatom selected  
 from nitrogen, oxygen or sulfur; and Y is selected from linear or branched  
 alkylene, monocyclic or polycyclic alkylene, arylene, aralkylene, polyoxyalkylene,  
 linear or branched alkenylene, monocyclic or polycyclic alkenylene, aromatic or  
 15 non-aromatic heterocyclic diradical and alicyclic diradical groups, the alkyl, aryl,  
 aralkyl, heterocyclic ring, carbocyclic ring, linear or branched alkylene,  
 monocyclic or polycyclic alkylene, arylene, aralkylene, polyoxyalkylene, linear or  
 branched alkenylene, monocyclic or polycyclic alkenylene, aromatic or non-  
 aromatic heterocyclic diradical and alicyclic diradical being unsubstituted or  
 20 substituted.

14. The compound of claim 13 wherein Y is linear or branched alkylene.
15. The compound of claim 13 wherein each of  $R_{32}$ ,  $R_{34}$ , and  $R_{36}$  are  
5 independently hydrogen.
16. The compound of claim 13 wherein  $R_{24}$  and  $R_{26}$  taken together form a direct bond.
- 10 17. The compound of claim 13 wherein  $R_{24}$  and  $R_{26}$  taken together form  $-(CH_2)_{n1}(O)_{n2}(CH_2)_{n3}-$ .
18. The compound of claim 13 wherein  $R_{24}$  and  $R_{26}$  taken together with the carbon atoms to which they are attached form a carbocyclic ring.  
15
19. An antireflective coating composition comprising:  
a) the polymer according to claim 1; and  
b) at least one crosslinking agent.
- 20 20. The composition of claim 19 wherein for a), the polymer further comprises an additional monomer.
21. The composition of claim 20 wherein the additional monomer is selected from optionally substituted acrylic esters, optionally substituted acrylic acids,  
25 optionally substituted methacrylic esters, optionally substituted methacrylic acids, optionally substituted acrylamides, optionally substituted methacrylamides, optionally substituted allyl compounds, optionally substituted styrenes, optionally substituted hydroxystyrene, optionally substituted hydroxyisopropylstyrene, optionally substituted methylstyrene, optionally substituted  
30 hydroxymethylstyrene, optionally substituted hydroxyl- $\alpha$ -methylstyrene, optionally substituted vinyl ethers, optionally substituted vinyl esters, optionally substituted

crotonic acids, optionally substituted crotonic acid esters, optionally substituted maleic anhydride, optionally substituted dialkyl itaconates, optionally substituted monoalkyl or dialkyl esters of maleic acid or fumaric acid, and mixtures thereof.

- 5    22.    The composition of claim 20 wherein the additional monomer is selected from optionally substituted methacrylates and optionally substituted styrenes.

23.    The composition of claim 22 wherein the methacrylic esters contains a pendent hydroxyl group.

10

24.    The composition of claim 19 wherein for a), the polymer comprises a repeating unit represented by formula (I).

25.    The composition of claim 24 wherein Y is linear or branched alkylene.

15

26.    The composition of claim 24 wherein each of  $R_{32}$ ,  $R_{34}$ , and  $R_{36}$  are independently hydrogen.

20

27.    The composition of claim 24 wherein  $R_{24}$  and  $R_{26}$  taken together form a direct bond.

28.    The composition of claim 24 wherein  $R_{24}$  and  $R_{26}$  taken together form  $-(CH_2)_{n1}(O)_{n2}(CH_2)_{n3}-$ .

25

29.    The composition of claim 24 wherein  $R_{24}$  and  $R_{26}$  taken together with the carbon atoms to which they are attached form a carbocyclic ring.

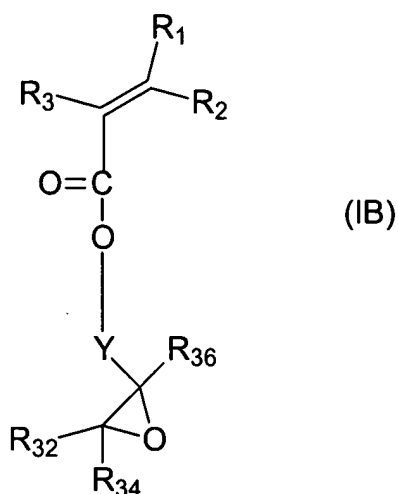
30.    The composition of claim 19 wherein for a), the polymer comprises a repeating unit represented by formula (II).

30

31. The composition of claim 19 wherein b) the crosslinking agent is selected from aminoplasts, isocyanates and mixtures thereof.

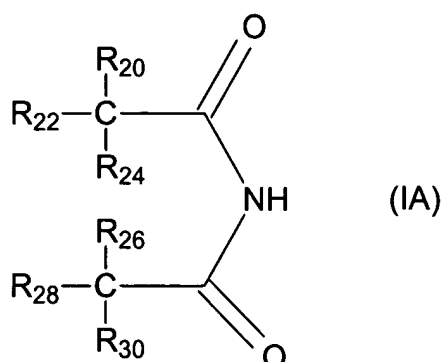
32. The composition of claim 19 which further comprises at least one additional component selected from solvents, cross-linking catalysts, monomeric dyes, surface leveling agents, adhesion promoters, and antifoaming agents.

33. A method of making the compound of claim 13 comprising reacting a compound of formula (IB)



where  $R_1$ ,  $R_2$ , and  $R_3$  are each independently selected from hydrogen or alkyl;  $R_{32}$ ,  $R_{34}$ , and  $R_{36}$  are independently selected from hydrogen, alkyl, aryl, aralkyl, or 5-, 6-, or 7-membered heterocyclic ring containing at least one heteroatom selected from nitrogen, oxygen or sulfur; and Y is selected from linear or branched alkylene, monocyclic or polycyclic alkylene, arylene, aralkylene, polyoxyalkylene, linear or branched alkenylene, monocyclic or polycyclic alkenylene, aromatic or non-aromatic heterocyclic diradical and alicyclic diradical groups, the alkyl, aryl, aralkyl, heterocyclic ring, carbocyclic ring, linear or branched alkylene, monocyclic or polycyclic alkylene, arylene, aralkylene, polyoxyalkylene, linear or branched alkenylene, monocyclic or polycyclic alkenylene, aromatic or non-aromatic heterocyclic diradical and alicyclic diradical being unsubstituted or substituted,

with a compound of formula (IA)



- 5 where  $R_{20}$ ,  $R_{22}$ ,  $R_{24}$ ,  $R_{26}$ ,  $R_{28}$ , and  $R_{30}$  are independently selected from hydrogen, alkyl, aryl, aralkyl, or 5-, 6-, or 7-membered heterocyclic ring containing at least one heteroatom selected from nitrogen, oxygen or sulfur, or  $R_{24}$  and  $R_{26}$  taken together (i) form a direct bond, (ii) form  $-(CH_2)_{n1}(O)_{n2}(CH_2)_{n3}-$  where  $n_2$  is 0 or 1 and  $n_1+n_2+n_3 = 1$  to 5, or (iii) with the carbon atoms to which they are attached
- 10 form a carbocyclic ring and  $R_{20}$ ,  $R_{22}$ ,  $R_{28}$  and  $R_{30}$  are as defined above, the alkyl, aryl, aralkyl, heterocyclic ring, and carbocyclic ring being unsubstituted or substituted,

15 in the presence of a catalyst and separating the compound of claim 13 from the reaction mixture.

34. The method of claim 33 wherein Y is linear or branched alkylene.

35. The method of claim 33 wherein each of  $R_{32}$ ,  $R_{34}$ , and  $R_{36}$  are

20 independently hydrogen.

36. The method of claim 33 wherein  $R_{24}$  and  $R_{26}$  taken together form a direct bond.



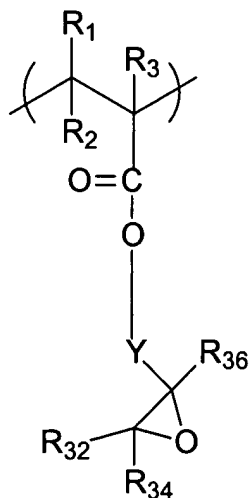
37. The method of claim 33 wherein  $R_{24}$  and  $R_{26}$  taken together form  $-(CH_2)_{n1}(O)_{n2}(CH_2)_{n3}-$ .

38. The method of claim 33 wherein  $R_{24}$  and  $R_{26}$  taken together with the  
5 carbon atoms to which they are attached form a carbocyclic ring.

39. A method of making the polymer of claim 1 having a repeating unit of  
formula (I) which comprises reacting a vinyl polymer or copolymer containing  
from about 40 to about 100 mol % of an epoxy substituent and an imide in the  
10 presence of a catalyst and separating the polymer of claim 1 having the  
repeating unit of formula (I) from the reaction mixture.

40. The method of claim 39 wherein the vinyl polymer or copolymer comprises  
at least one repeating unit having the formula

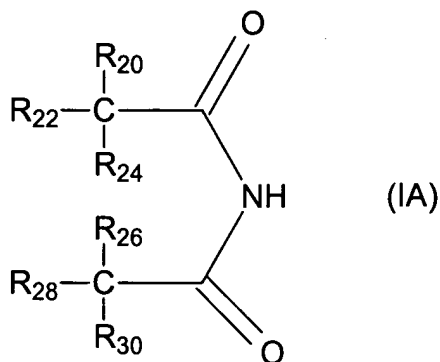
15



where  $R_1$ ,  $R_2$ , and  $R_3$  are each independently selected from hydrogen or alkyl;  
and  $Y$  is selected from linear or branched alkylene, monocyclic or polycyclic  
20 alkylene, arylene, aralkylene, polyoxyalkylene, linear or branched alkenylene,  
monocyclic or polycyclic alkenylene, aromatic or non-aromatic heterocyclic  
diradical and alicyclic diradical groups, the alkyl, linear or branched alkylene,  
monocyclic or polycyclic alkylene, arylene, aralkylene, polyoxyalkylene, linear or

branched alkenylene, monocyclic or polycyclic alkenylene, aromatic or non-aromatic heterocyclic diradical and alicyclic diradical being unsubstituted or substituted.

- 5 41. The method of claim 39 wherein the imide is



- where  $R_{20}$ ,  $R_{22}$ ,  $R_{24}$ ,  $R_{26}$ ,  $R_{28}$ , and  $R_{30}$  are independently selected from hydrogen, alkyl, aryl, aralkyl, or 5-, 6-, or 7-membered heterocyclic ring containing at least one heteroatom selected from nitrogen, oxygen or sulfur, or  $R_{24}$  and  $R_{26}$  taken together (i) form a direct bond, (ii) form  $-(CH_2)_{n1}(O)_{n2}(CH_2)_{n3}-$  where  $n_2$  is 0 or 1 and  $n_1+n_2+n_3 = 1$  to 5, or (iii) with the carbon atoms to which they are attached form a carbocyclic ring and  $R_{20}$ ,  $R_{22}$ ,  $R_{28}$  and  $R_{30}$  are as defined above, the alkyl, aryl, aralkyl, heterocyclic ring and carbocyclic ring being unsubstituted or substituted.

15

42. The method of claim 40 wherein Y is linear or branched alkenylene.

43. The method of claim 40 wherein each of  $R_{32}$ ,  $R_{34}$ , and  $R_{36}$  are independently hydrogen.

20

44. The method of claim 41 wherein  $R_{24}$  and  $R_{26}$  taken together form a direct bond.

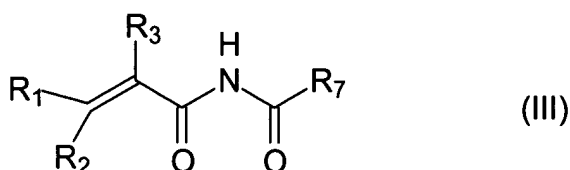
45. The method of claim 41 wherein  $R_{24}$  and  $R_{26}$  taken together form

25  $-(CH_2)_{n1}(O)_{n2}(CH_2)_{n3}-$ .

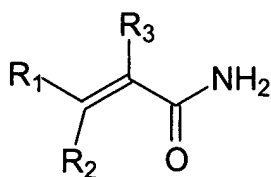
46. The method of claim 41 wherein R<sub>24</sub> and R<sub>26</sub> together with the carbon atoms to which they are attached form a carbocyclic ring.

5 47. The method of claim 39 wherein the polymer comprises an additional monomer selected from optionally substituted acrylic esters, optionally substituted acrylic acids, optionally substituted methacrylic esters, optionally substituted methacrylic acids, optionally substituted acrylamides, optionally substituted methacrylamides, optionally substituted allyl compounds, optionally substituted styrenes, optionally substituted hydroxystyrene, optionally substituted hydroxyisopropylstyrene, optionally substituted methylstyrene, optionally substituted hydroxymethylstyrene, optionally substituted hydroxyl- $\alpha$ -methylstyrene, optionally substituted vinyl ethers, optionally substituted vinyl esters, optionally substituted crotonic acids, optionally substituted crotonic acid esters, optionally substituted maleic anhydride, optionally substituted dialkyl itaconates, optionally substituted monoalkyl or dialkyl esters of maleic acid or fumaric acid, and mixtures thereof.

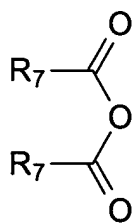
48. A method of making a compound having formula (III) comprising



reacting a compound having formula (IIIa) with a compound having formula (IIIb)



(IIIa)



(IIIb)

where R<sub>1</sub>, R<sub>2</sub>, and R<sub>3</sub> are each independently selected from hydrogen or alkyl;  
and R<sub>7</sub> is alkyl or aryl,

in the presence of a catalyst and separating the compound of formula (III) from

5 the reaction mixture.

49. A process for forming an image on a substrate comprising,

a) coating the substrate with the composition of claim 19;

10 b) heating the coating of step a);

c) forming a coating from a photoresist solution on the coating of step

b);

d) heating the photoresist coating to substantially remove solvent from  
the coating;

15 e) image-wise exposing the photoresist coating;

f) developing an image using an aqueous alkaline developer;

g) optionally, heating the substrate prior to and after development; and

h) dry etching the composition of step b).

20 50. The process of claim 49, where the photoresist comprises a non-aromatic  
polymer, a photoactive compound and a photoresist solvent.

51. The process of claim 49, where the antireflective coating is baked at  
temperatures greater than 90°C.

25